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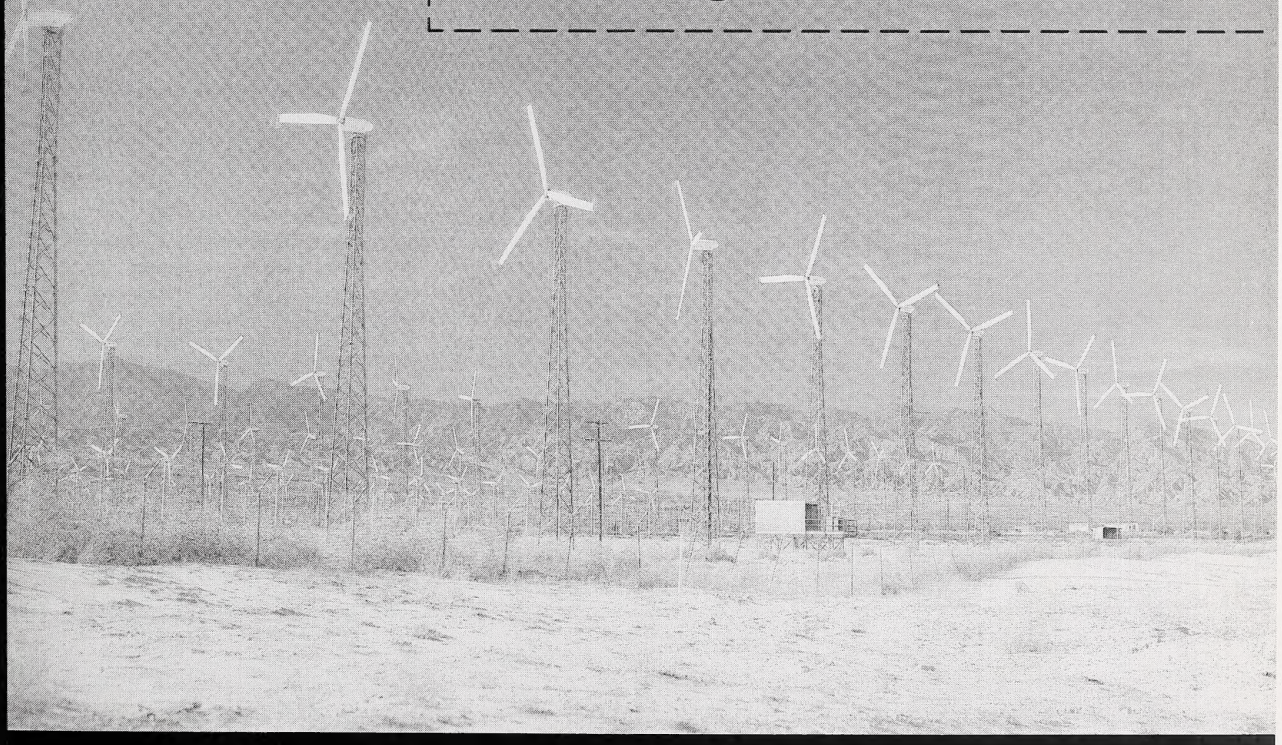
SCIENCE 7

Module 3 Heat and Temperature

Home Instructor's Guide and Assignment Booklet 3A



Learning Technologies Branch

Alberta LEARNING

Science 7
Module 3: Heat and Temperature
Home Instructor's Guide and Assignment Booklet 3A
Learning Technologies Branch
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The Learning Technologies Branch acknowledges with appreciation the Alberta Distance Learning Centre and Pembina Hills Regional Division No. 7 for their review of this Home Instructor's Guide and Assignment Booklet.

This document is intended for	
Students	✓
Teachers	✓
Administrators	
Home Instructors	✓
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Other	

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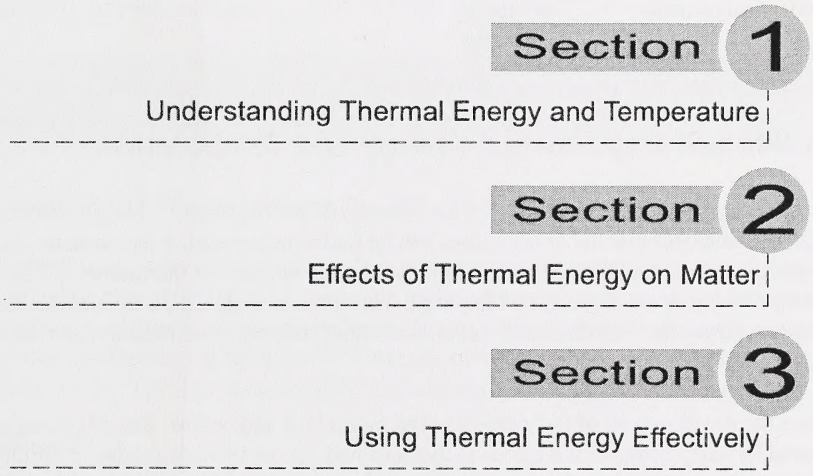
Module 3: Heat and Temperature

The major emphasis of this module is **Social and Environmental**.

In this module, the student will see that people need to produce, transfer, and transform heat energy to meet their energy needs. In finding out about the nature of heat, the student will investigate sources and uses of heat energy. The student will explore different technologies, investigate the scientific principles involved, and consider questions about the nature of heat. The student will use the particle model of matter to understand the relationship between heat and temperature and to explain observations that include expansion, contraction, and changes of state. The student will also think seriously about the long-term ability to meet thermal energy needs from fossil fuels and renewable resources.



Key Concepts

The following concepts are developed in this module and may also be addressed at other grade levels.

- heat energy needs and technologies
- thermal energy
- particle model of matter
- temperature
- thermal expansion
- change of state
- heat transfer
- thermal energy sources
- energy conservation

Assessment

In this module, students are expected to complete three section assignments and a final module assignment. Their grading in this module is based on the assignments they submit. The mark distribution is as follows:

The assignment breakdown is as follows:

Assignment Booklet 3A	
Section 1 Assignment	36 marks
Section 2 Assignment	57 marks
Assignment Booklet 3B	
Section 3 Assignment	50 marks
Final Module Assignment	66 marks
TOTAL	209 marks

Section 1: Understanding Thermal Energy and Temperature

In this section, the student will come to understand what is involved in temperature changes—warming and cooling. The student will discover that his or her senses can be fooled in measuring temperature, thus coming to the realization that people need a reliable instrument to measure temperature—a thermometer. The student will take a close look at the Celsius scale (the most widely used thermometer scale on Earth) and the Kelvin scale (the scale used by scientists). He or she will also study other instruments that measure heat and as well as instruments that regulate heat.

The student will trace the development of technologies used to produce and control thermal energy. He or she will go from sod huts (used by early settlers) and igloos to methods and means by which today's buildings are heated. The student will compare how tasks were completed a hundred years ago to how they are addressed today. From this, the student will see that human needs have pushed the development of new technologies.

The student will use the particle model of matter—a model that depicts matter as being composed of extremely tiny particles in motion—to understand the difference between temperature and thermal energy. He or she will also use this model to make a connection between thermal energy and other forms of energy.

The following materials will be needed to complete this section.

Section 1: Lesson 2

- water
- small, glass bottle with a narrow neck (e.g., pop bottle)
- drinking straw
- dishcloth (or sponge)
- ruler
- calculator
- food colouring
- modelling clay

Suggested Answers

Section 1: Lesson 1

1. **Textbook questions 1 and 2 of "Analyze," p. 189**

    1. It is likely that the most common energy sources will be natural gas (for heating) and electricity (for cooking).

    2. Answers will vary. A sample answer is given.

        I live in the country where there are no natural gas lines yet. We use propane to heat our home. We do use electricity to cook our food.

        Note to home instructor: In places where natural gas is not available, most heat their homes using propane or heating oil. Cooking is mostly done with electricity.

3. **Textbook question 1 of "Topic 1 Review," p. 191**

    1. Answers will vary. Text examples include scorched food, fire and burn danger, control problems, fire places drawing heated air from the room and up the chimney (inefficiency), uneven heating, condensation, messiness, and inconvenience. These problems were diminished or resolved with changes like modern, clean-burning fuels and new energy sources; a variety of control and transfer systems with built-in safety devices; fire-resistant fabrics; and improved construction and insulation of buildings.

Section 1: Lesson 2

9. **Textbook questions 1 and 2 of "Evaluate," Part 1, p. 197**

    1. The water in the tube changes height in response to temperature.

        a. The water moves down when the air in the bottle warms up.

        b. The water moves up when the air in the bottle cools down.

    2. Calibrations (markings at equal intervals) allow for more precise, quantitative measurements of the changes in height that the water makes in response to temperature changes.

10. **Textbook questions 1, 2, and 3 of "Evaluate," Part 2, p. 197**

    1. Answers will vary. Check through the specifications listed on page 196 of the textbook with the student.

    2. Answers will vary. The student should mention specific problems and possible solutions to them.

3. Answers will vary. Some reasons are as follows

   - scale too small
   - leaky
   - affected by hand pressure
   - water would evaporate or get stale
   - difficult to transport
   - must be set up each time it is used
   - scales could vary from one person's thermometer to the next
   - uncalibrated scale provides only qualitative data
   - not very accurate

13. **Textbook questions 1, 2, 4, and 5 of "Topic 2 Review," p. 201**

1. a. Your body temperature would have remained close to 37°C.

   b. Your body would have become used to the high surrounding air temperatures. Your skin sensors would have detected a drop of 5°C and, thus, you would have felt cooler.

2. Look at the diagrams on page 199 to help visualize this answer. A small glass capsule of mercury is attached to a bimetallic (two-metal) strip. Mercury is a heavy liquid metal that can transmit electricity. When the temperature drops, the bimetallic strip contracts and uncoils somewhat (due to differences in the amount each metal expands), tipping the mercury capsule. It rolls downward, creating a contact between two wires. Electricity flows through the completed circuit and turns the furnace on. As the temperature rises, the bimetallic strip expands, causing the mercury capsule to tip in the other direction. The mercury rolls away from the contact wires, thus breaking the circuit and shutting the furnace off.

4. Household appliances that use a thermostat include furnaces, ovens, baseboard heaters, refrigerators, freezers, air conditioners, hot-water tanks, and blow dryers.

5. a. bimetallic strip: An electric frying pan must keep the heat at approximately the same temperature.

   b. recording thermometer: These create a printout of measurements.

   c. infrared thermogram: These can be housed in satellites or planes that fly overhead.

   d. thermocouple: When temperatures are very high, other devices would be destroyed or incapable of operating.

   e. infrared thermogram: These do not actually have to touch the wheel bearings and can be used while the train is operational.

   f. recording thermometer: These print out measurements over a longer period of time, detecting small temperature changes.

Section 1: Lesson 3

13. a. The pot of soup has more thermal energy. Both samples are at the same temperature (energy level), but the pot contains many more particles to hold energy.

    b. They are at the same temperature.

    c. Energy is transferred to the air particles because they are at a lower temperature. This results in an increase in the speed of the air particles and a decrease in the speed of the soup particles.

14. a. The soup at 100°C has the highest average energy. The soup at 10°C. has the lowest average energy. Temperature is the indicator of the average energy level of the particles in a substance. As the average energy of the particles in a substance increases, its temperature increases.

    b. The 100°C sample contains the most thermal (total kinetic) energy because it has the same number of particles as the others but a higher temperature.

15. a. Temperature indicates that the teaspoon of soup has the greater average kinetic energy.

    b. The bowl of soup has the greater total kinetic energy. It looks to have a lot more particles to hold energy. The difference in temperature isn't that great. So, the total kinetic energy of a whole lot of warm particles would be higher than the total of the few hotter particles.

16. a. The chicken broth has a higher temperature.

    b. The heat energy moves from the chicken broth to the tongue (from higher average energy level to lower average energy level).

    c. A lot of heat energy is transferred to your tongue very quickly, damaging the tissue in your tongue.

17. **Textbook questions 2, 3, 4, 6, and 7 of "Topic 3 Review," p. 208**

    2. Particles are extremely tiny. They are much too small to see even with our most sophisticated technology. Like you, scientists rely on indirect evidence of many different types to study particles and their behaviour.

    3. Answers will vary. A sample answer is provided.

       Energy changes a piece of wood into gases and ash as the wood burns, and energy changes raw meat into cooked meat.

    4. a. James Joule invented devices for studying the effect of particle motion on temperature.

       b. Anders Celsius created the Celsius temperature scale.

       c. Lord Kelvin introduced the concept of absolute zero and created the Kelvin temperature scale, which is used for measuring very low temperatures.

6. Science is a work in progress—an ongoing, never ending process. It is important to know that science is a body of knowledge and procedures that progresses based on the ideas and technologies of the past and present. Scientific knowledge grows from the interactions of ideas of many people from a variety of scientific and non-scientific views and backgrounds. We continually gain new information adding to and revising or rejecting current information. Being aware of past theories and techniques helps you understand and appreciate the process of science. It also makes you aware of the need for all of us to have a questioning attitude and an open mind.

7. Answers will vary. Some examples are electricity, nuclear (atomic), and solar energy.

Section 1 Review

1. **Textbook question 1 of "Reviewing Key Terms," p. 209**

1. (a) P A R **T** I C L E
   (b) T **H** E R M O M E T E R
   (c) E N **E** R G Y
   (d) C A L I B **R** A T E
   (e) T E **M** P E R A T U R E
   (f) S C **A** L E S
   (g) C E **L** C I U S

2. **Textbook questions 2, 3, 4, 7, and 9 of "Understanding Key Concepts," p. 209**

2. freezing water: 0°C
   room temperature: 20°C to 22°C
   normal human body temperature: 37°C
   boiling water: 100°C

3. To calibrate a thermometer, follow these steps:

   step 1: Place the thermometer in finely crushed ice. Mark and label the fluid level as 0°C.

   step 2: Place the thermometer in boiling water (in pure water and at sea level is most accurate). Mark and label the fluid level as 100°C.

   step 3: Divide the space in between the two measurements into evenly spaced graduations, ranging from the 0°C mark to the 100°C mark. Graduations could represent 1, 2, 5, 10, or even 20°C.

4. a. Thermometers indicate (measure) the temperature of a substance.

   b. Thermometers actually indicate the speed/energy level of the particles in a substance (the average kinetic energy).

7.

Comparing Thermal Energy and Temperature		
	Thermal Energy	**Temperature**
SI units of measurement	joule (J)	degrees Celsius (°C) or Kelvins (K)
what it tells about particles of matter	total kinetic energy	average kinetic energy
measuring device or method	calculated using the mass of the matter and the temperature	thermometer

9. a. As particle motion increases, the temperature **increases**.

   b. As thermal energy increases, particles in a substance move **faster**.

   c. As thermal energy increases, particles' average speed **increases**.

Section 2: Effects of Thermal Energy on Matter

In this section the student applies his or her knowledge of the particle model and thermal energy to real-life situations. He or she determines that solids, liquids, and gases all expand when heated and contract when cooled. The student discovers that gases expand more than liquids and liquids more than solids. Furthermore, he or she discovers that substances, in general, have different rates of expansion.

The student observes matter changing states and explains his or her observations using the particle model of matter. He or she also determines that matter moves continuously between these states. The student demonstrates that energy is always being transferred from one area to another and from one form to another. He or she then discovers that there are three methods of heat transfer and will use the particle model in explaining heat transfer. Based on the principles of heat transfer, the student designs ways to conserve thermal energy.

The following materials will be needed to complete this section.

Section 2: Lesson 1

- long, copper or iron wire
- 200 g or 500 g hooked mass (e.g., coffee mug)
- metre-stick
- candles
- matches
- round balloon
- ruler
- string
- felt marker

Section 2: Lesson 2

- thermometer
- stirring rod
- heat source (e.g., stove, hot plate)
- 2, 250-mL beakers (or a pot and glass)
- clock or watch
- crushed ice
- water

Section 2: Lesson 3

- 2 empty pop cans
- thermometer
- light (at least 100 W)
- ruler
- dark- and light-coloured cloth (or black and white paper or paint)
- aluminum foil
- 200 mL of cooking oil
- tape or rubber bands
- plastic (e.g., from a pen)
- copper wire
- long, iron nails
- wooden craft sticks (or pencils)
- water
- candle
- matches
- ice cubes
- various insulating materials

Suggested Answers

Section 2: Lesson 1

7. **Textbook questions 1, 2, and 3 of "Analyze," p. 212**

   1. a. The wire is getting longer, allowing the mass to move down.

      b. The wire is getting shorter.

   2. Answers will vary depending on the student's prediction. A sample answer is given.

      The student's prediction was "The weight will go lower and then return to its starting point as the wire warms and cools." You would expect their observations to support this prediction.

3. Answers will vary depending on the student's hypothesis. A sample answer is given.

   The student's hypothesis was "When a material is heated, it will get bigger." You would expect their observations to support this hypothesis.

8. a. **Textbook questions 1 to 4 of "Analyze," p. 213**

   1. When both the ball and the ring were at room temperature, the ball did not fit through the ring. When the ring was heated, the metal expanded and the hole got larger, allowing the ball to pass through the ring.

   2. With the ring hot and the ball cold, the ball will pass through the ring. However, if the ring is allowed to cool (or placed in cold water), the ball will no longer fit through the ring. This observation provides evidence that the metal contracted as it cooled.

   3. Answers will vary depending on the student's hypothesis.

   4. When a substance is heated, the particles gain kinetic energy and start to move faster and hit each other harder. As a result, the particles move further apart (spaces between the particles increase) and the volume of the substance increases (expands). As an object or substance cools, its particles lose kinetic energy, slow down, and move closer together—the substance contracts (volume decreases).

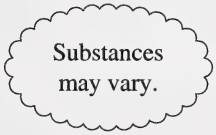
   b. **Textbook question 5 of "Conclude and Apply," p. 213**

   5. As the temperature drops in winter, the wires will contract, causing them to sag less. If the wires were hung too tightly in the summer, they could snap when they contract due to the cooler winter temperatures.

14. **Textbook questions 1, 2, and 3 of "Topic 4 Review," p. 217**

   1. The three states of matter are

      - solid (e.g., steel)
      - liquid (e.g., cooking oil)
      - gas (e.g., carbon dioxide)

   2. a. Solids, liquids, and gases expand when warmed. **Note:** This is a generalization. Water, however, expands when freezing.

      b. Solids, liquids, and gases contract when cooled. **Note:** In general, this is true. However, ice contracts when melting.

   3. Solids expand and contract the least. Gases expand and contract the most.

Section 2: Lesson 2

3. a. **Textbook questions 1 to 4 of "Part 1: Rate of Temperature Change," p. 219**

1. and 2.

Material	Rate of Temperature Change	Specific Heat Capacity
sand on beach	warms more quickly	lower because it absorbs less energy per °C
water in lake	warms more slowly	higher because it absorbs more energy per °C

3. and 4.

Predicting Specific Heat Capacities		
Material	**Rate of Temperature Change**	**Specific Heat Capacity**
bottom of cooking pot	warms quickly	low
cold pack for treating injuries	warms slowly	high
solid glue in a glue gun	warms quickly	low

b. **Textbook questions 5, 6, and 7 of "Part 2: Size of Temperature Change," p. 219**

5. Steel warmed and cooled faster. It showed the greatest change in temperature when the same amount of heat was added or removed.

6. Antifreeze has the higher specific heat capacity because its temperature changes the least when the same amount of thermal energy was added or removed.

7. (c) Material with a high specific heat capacity warms slowly and cools slowly.

14. **Textbook questions 1 to 4 of "Topic 5 Review," p. 225**

1. a. freezing, condensation, and sublimation (gas to solid)

b. melting, evaporation, and sublimation (solid to gas)

c. melting, evaporation, and sublimation (solid to gas)

2. a. The particles are moving faster.

   b. The particles are moving slower.

   c. The temperature falls.

   d. The change of state that is occurring is evaporation.

3. a. Oxygen is a liquid between – 218°C and – 183°C.

   b. Table salt is a gas above 1413°C.

   c. Tin is a liquid between 232°C and 2606°C.

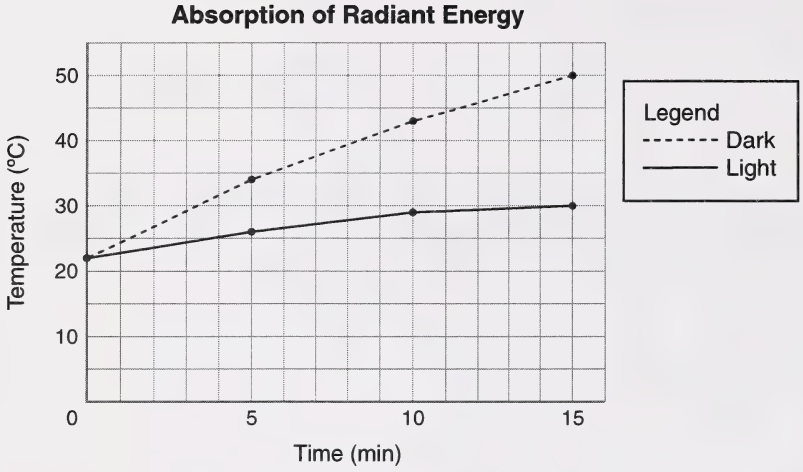
4. The six changes of state are

   - melting (fusion)—solid to liquid
   - freezing (solidification)—liquid to solid
   - condensation—gas to liquid
   - evaporation—liquid to gas
   - sublimation—solid to gas
   - sublimation—gas to solid

Section 2: Lesson 3

6. Students used different procedures, so the amount of heat will differ. However, dark containers should reach higher temperatures than light ones. Dull-surfaced containers should reach higher temperatures than shiny ones. Answers will vary. Sample data is given.

Absorption of Radiant Energy		
Time (min)	Temperature (°C)	
	Light	Dark
0	22	22
5	25	34
10	29	43
15	30	50



7. **Textbook questions 1, 3, and 4 of "What Did You Find Out?," p. 227**

   1. Answers will vary depending on what is tested. Dark, dull, rough surfaces should have produced higher temperatures than light, shiny, smooth surfaces. Based on sample results (question 6), the temperature change for the light-coloured container was 8°C. For the dark one, the change was 28°C.

   3. Factors that affect the absorption of radiant energy include colour, texture, shininess, distance and angle from source, position of thermometer, and surface area of test material.

   4. a. The dark surface radiates energy better. Therefore, the dark surface (loses thermal energy faster and) cools down more quickly.

      b. The dull surface radiates energy better. Therefore, the dull surface cools down more quickly.

25. **Textbook questions 1 to 4 of "Topic 6 Review," p. 236**

   1. An *energy source* supplies the initial energy to a system. Common types of energy that can come from a source include the following:

      - kinetic energy (Thermal energy and mechanical energy are different forms of kinetic energy.)
      - the energy of moving things, such as wind and a ball
      - thermal energy—the energy of moving particles
        For example, hot water from deep in the Earth has geothermal energy.
      - gravitational energy—the energy of position
        For example, a lead ball held 10 m off the ground has gravitational energy.

- chemical energy—energy stored in the bonds between particles
  Food and fossil fuels have chemical energy.

- electrical energy—the energy of moving electrons
  Chemical energy stored in a battery is released as electrical energy.

- mechanical energy—the energy of the moving parts of a mechanical device
  A moving arm and an operating engine have mechanical energy.

2. The five features of all energy transfer systems are

   - an energy source
   - a direction of transfer
   - energy transformation(s)
   - controls
   - waste heat

3. a. The final temperature should be 30°C. You know from personal experience that when you add hot and cold water together you get warm water. The final temperature is in the middle because there is an equal amount of hot water and cold water.

   b. Energy was transferred from the hot water particles to the cold water particles.

4. a. The source of the heat was the wood being burned in the stove.

   b. The chemical energy of the wood was converted to heat energy by burning.

   c. The fire radiates thermal energy. The air particles in the stove conduct the heat to the stove and carry it upward by convection. The hot wood conducts heat to the iron stove. The stove conducts heat to the air outside the stove.

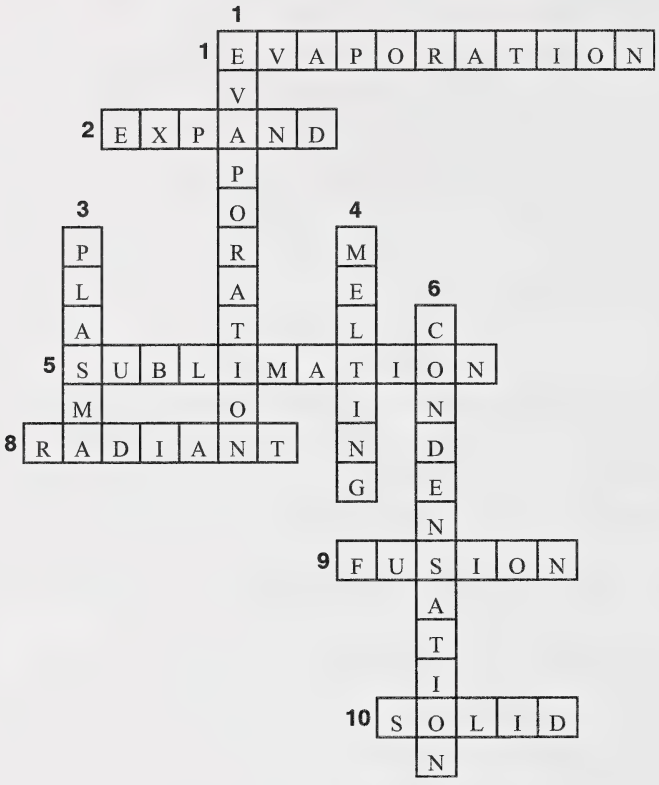
      Heat is moved through the house by convection. The kitchen receives a certain amount of radiant heat energy. Some thermal energy reaches the upstairs hallway by conduction from the stove pipe. Thermal energy of hallway air reaches the bedrooms by convection. Any thermal energy reaching the rooms in the rest of the house is transferred by convection.

   d. Some of the heat was carried out of the house by convective heat transfer through the chimney.

   e. The wood stove in the kitchen heats the entire house.

Section 2 Review

1. **Textbook question 1 of "Reviewing Key Terms," p. 237**



2. **Textbook question 4 of "Understanding Key Concepts," p. 237**

4. a. Graph A is the cooling curve, and Graph B is the warming curve. When a substance is being cooled, its volume decreases (as in Graph A). When it is being heated, its volume expands (as in Graph B).

   b. Graph B illustrates what happens when a thermometer is placed in a pot on a stove. Graph A illustrates what happens when the thermometer is placed in a jug of water that was just put in a refrigerator.

ASSIGNMENT BOOKLET 3A

Science 7
Module 3: Section 1 Assignment and Section 2 Assignment

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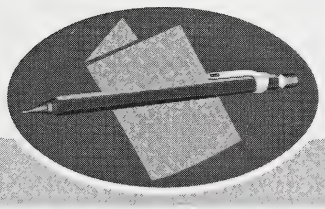
Science 7

Module 3

Heat and Temperature

Assignment Booklet 3A



Learning Technologies Branch

Alberta LEARNING

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Summary

	Total Possible Marks	Your Mark
Section 1 Assignment	36	
Section 2 Assignment	57	
	93	

Teacher's Comments

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Module 3: Heat and Temperature
Assignment Booklet 3A
Learning Technologies Branch

The Learning Technologies Branch acknowledges with appreciation the Alberta Distance Learning Centre and Pembina Hills Regional Division No. 7 for their review of this Home Instructor's Guide and Assignment Booklet.

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ASSIGNMENT BOOKLET 3A
SCIENCE 7: MODULE 3
SECTION 1 ASSIGNMENT AND SECTION 2 ASSIGNMENT

Your mark for this module will be determined in part by how well you do your assignments.

This Assignment Booklet is worth 93 marks out of the total 209 marks for the assignments in Module 3. The value of each assignment and each question is stated in the left margin.

Work slowly and carefully. If you have difficulty, go back and review the appropriate topic.

Be sure to proofread your answers carefully.

(36)

Section 1 Assignment: Understanding Thermal Energy and Temperature

Read all parts of your assignment carefully and record your answers in the appropriate places.

(2) 1. The igloo and the sod shack are both ways to protect people from their environment. List two additional ways these buildings are similar.

_____

_____

For questions 2 and 3, read each question carefully. Decide which of the choices BEST answers the question. Place your answer in the blank space given.

(1) _____ 2. Which method was most likely used to heat a sod shack?

A. a wood or coal stove
B. a natural gas furnace
C. heating oil in a furnace
D. electricity from a coal-fired generating plant

(1) _____ 3. Technology has allowed changes in the way people carry out tasks. Why might an electric stove be preferred over a coal stove?

A. instant heat
B. fine control of heat
C. no need to keep coal supplies
D. all of the above

Return to page 16 of the Student Module Booklet and begin Lesson 2.

Read question 4 carefully. Decide which of the choices BEST answers the question. Place your answer in the blank space given.

(1)

_____ 4. Why would a person in Alberta have trouble calibrating a thermometer to the Celsius scale?

A. Water boils at a lower temperature in Alberta.
B. Water freezes at a lower temperature in Alberta.
C. The Celsius scale is no longer used.
D. The proper kind of salt water cannot be obtained in Alberta.

(3)

5. Put each object listed into the proper column of the chart.

- boiling steel
- a tree on a hot, summer day
- an ice cube floating in a glass of cold water

Gives Off Infrared Radiation	Does NOT Give Off Infrared Radiation

(2)

6. Why does 10°C seem warm in the winter and cold in the summer?

_____

_____

_____

_____

_____

7. Two devices used to measure temperatures are given. Explain how each device works.

(2) **thermocouple:** _____

_____

_____

(2) **bimetallic strip:** _____

_____

_____

8. Name the device that would be best suited for the following.

(1) a. controlling the temperature of an iron

_____

(1) b. determining the temperature of a volcano

_____

(1) c. helping find a child lost in a heavily forested area

_____

(1) d. recording the temperature of a sauna over 7 days

_____

Return to page 22 of the Student Module Booklet and begin Lesson 3.

(3)

9. It is a cold winter night. You have been lost in the woods. You find a cabin. Beside it is a small shed. The cabin is locked and there is no way in. You think, "This is probably for the best since I only have a candle to keep me warm." Why is the small shed a better place for you and your candle than the much larger cabin?

(4)

10. There are four samples of the same substance, each at a different temperature. Using the information given in the table, order the samples from lowest energy level (1) to highest energy level (4). Then order the samples from coolest (1) to warmest (4).

Sample	Movement of Particles	Energy Level	Relative Temperature
A	extremely low		
B	quite fast		
C	extremely fast		
D	quite slow		

Return to page 33 of the Student Module Booklet and begin the Section 1 Review.

(3) 11. Thermal energy and temperature are different. List three differences.

_____

_____

_____

_____

_____

_____

(3) 12. Use the particle model of matter to explain the following observations.

You pour cake batter into a pan and bake it in the oven for half an hour. You observe steam rising off the cake as you remove it from the oven. You immediately cover it with plastic wrap and leave it to cool. When you decide to have a piece of it later that evening, you notice drops of water hanging on the plastic wrap above the cake.

_____

_____

_____

_____

_____

_____

(5) 13. Read each statement carefully. Place a **T** in front of the statement if it is true. Place an **F** in front of the statement if it is false.

_____ Heat has mass.

_____ Burning coal creates energy.

_____ There are no spaces between particles in a solid.

_____ Energy transfers from a low energy source to a high energy receiver.

_____ Each particle in a cup of water at room temperature has the same kinetic energy.

Return to page 34 of the Student Module Booklet and begin Section 2.

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Section 2 Assignment: The Effects of Thermal Energy on Matter

Read all parts of your assignment carefully and record your answers in the appropriate places.

(1) 1. You have seen that cooling a substance, for the most part, makes it contract. How does ice forming at the top of a glass of water in the freezer show this is not always the case?

_____

_____

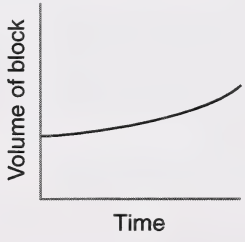
Read question 2 carefully. Decide which of the choices BEST answers the question. Place your answer in the blank space given.

(1) _____ 2. A 6-m metal bar increased in temperature by just over 100°C. Its length increased by nearly 1.4 cm. What was the metal?

A. aluminum
B. brass
C. copper
D. steel

Return to page 42 of the Student Module Booklet and continue with Lesson 1.

(3) 3. The sketch given shows changes in the volume of a solid metal block. Thermal energy was being exchanged between the air and the metal block. Which was warmer to start with? Explain how the sketch demonstrates this.



_____

_____

_____

(3)

4. You have the choice of using water, ethyl alcohol, or cooking oil to make a thermometer. The thermometer is for measuring outdoor temperatures in Alberta. Which substance would be the best choice? Why would it be the best choice?

_____

_____

_____

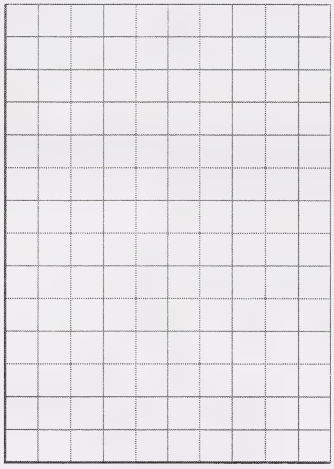
Return to page 46 of the Student Module Booklet and begin Lesson 2.

5. A scientist measured the temperature of a 1-kg sample of substance A every 5 min as thermal energy was added at a constant rate for 100 min. The substance was initially a solid. The data obtained is given in the following table.

Heating Substance A

Time (min)	Temperature (°C)	Area of Graph
0	–10	A
5	0	B
10	0	
15	0	
20	0	
25	12.5	C
30	25	
40	50	
55	87.5	
60	100	
70	100	D
90	100	
100	110	E

(8) a. Create a line graph using the data given in the table. Be sure your graph meets all the appropriate criteria. If you use a computer to graph the data, paste it over the blank grid given. (**Note:** The temperature data goes below 0°C.)



④ b. In the table given, do the following:

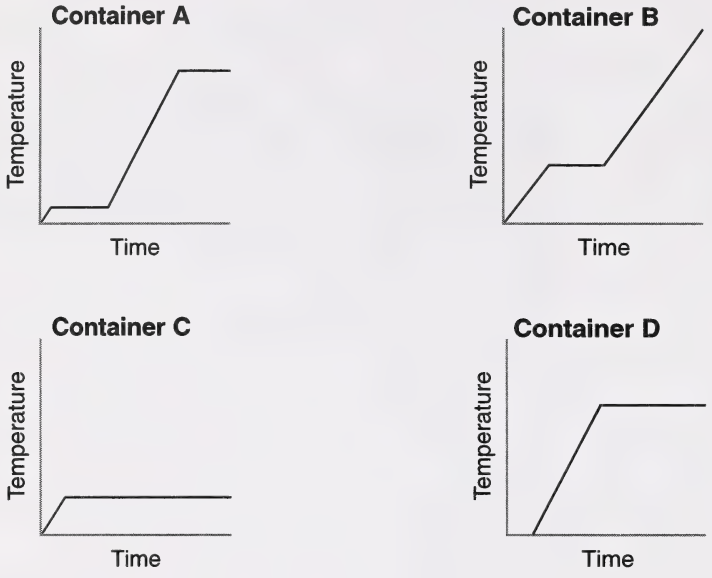
- Identify the process taking place in each area of the graph. (The first one is done for you.)
- Identify the state(s) present at each area of the graph. (The first one is done for you.)
- State whether the average energy level at each area of the graph is increasing, decreasing, or remaining the same. (The first one is done for you.)

Heating Curve Interpretation			
Area of Graph	**Process**	**State(s)**	**Average Energy Level**
A	**heating**	**solid**	**increasing**
B			
C			
D			
E			

Read question 6 carefully. Decide which of the choices BEST answers the question. Place your answer in the blank space given.

(1)

_____ 6. Four identical containers holding water were placed on a stove. Each container had the same amount of water and was heated for 5 min. Each burner on the stove gave off the same amount of heat. According to the graphs for each container, which container started with the coldest water? (**Hint:** Not all started with liquid water.)



A. Container A
B. Container B
C. Container C
D. Container D

(3)

7. The terms *condensing*, *evaporating*, *freezing*, *melting*, and *sublimation* all describe changes of state of matter. One of these changes is quite different than the other four. Which term describes this unique change? Why is it quite different than the others?

_____

_____

_____

_____

8. Identify the state(s) that has the following.

(1) a. an indefinite shape

_____

(1) b. a definite volume

_____

(1) 9. What happens to the average kinetic energy of the particles of a substance as it changes state?

_____

_____

10. State whether thermal energy is absorbed or released to produce the following changes of state.

(1) a. solidification

_____

(1) b. sublimation from a solid to a gas

_____

(1) c. condensation

_____

Return to page 54 of the Student Module Booklet and begin Lesson 3.

For questions 11 and 12, read each question carefully. Decide which of the choices BEST answers the question. Place your answer in the blank space given.

(1) _____ 11. Which term does **not** describe a means of thermal energy transfer?

A. conduction
B. convection
C. insulation
D. radiation

(1) _____ 12. Which amount of insulation would give the highest RSI value?

A. 5 cm of plywood
B. 8 cm of blue plastic foam
C. 10 cm of fibreglass
D. 12 cm of vermiculite

13. Min So is drying her hair with a blow dryer. Identify the following components of the energy transfer system.

(1) a. energy source

_____

(1) b. direction of heat energy transfers

_____

(1) c. transformations

_____

(1) d. waste heat

_____

(1) e. control system

_____

14. Complete the following statements. Use the items from the list given.

• active	• cooler	• particles	• resistance
• conduction	• heat	• passive	• thermal energy
• convection	• heat capacity	• radiation	• warmer

(1) a. When you determine how much energy an object must lose to lower its average energy level 1°C, you are determining its _____.

(1) b. To transfer heat by _____, no particles are necessary.

(1) c. To increase thermal energy without changing the average energy level of the particles, you must add more _____ of the same temperature.

(1) d. When you hold your hands 6 cm above a light bulb, most of the heat transfer you experience is by _____.

(1) e. If you hold a piece of copper wire in a flame, you can feel the heat that has been transferred by _____.

(1) f. The term _____ is used in reference to energy gained or lost by a material as it interacts with material at a different average energy level.

(1) g. The higher the RSI of a material, the higher its _____ to conductive heat transfer.

(2) h. Thermal energy always moves from _____ particles to _____ particles.

15. Complete the following statements. Use the items from the list given.

• active	• high	• low	• solids
• convection	• higher	• out	• temperature
• density	• in	• passive	• touch
• fluid	• liquid	• radiant	

(1) a. The principle form of thermal energy transfer in fluids is _____.

(1) b. A good insulator has a _____ RSI.

(1) c. When you place your hands 6 cm from the side of a light bulb, you experience _____ energy transfer.

(1) d. Conduction is the principal form of heat transfer in _____.

(2) e. Proper insulation keeps thermal energy _____ during the winter and _____ during the summer.

(1) f. Suppose 5 kg of substance A and 5 kg of substance B lose thermal energy at the same rate. Substance B takes longer to drop 10°C. Therefore, substance B has a _____ specific heat capacity.

(3) g. A convection current starts due to differences in _____ within a _____. These differences are the result of differences in _____.

(1) h. To transfer thermal energy by conduction, particles must _____.

Submit your completed Assignment Booklet 3A to your teacher for assessment.
Then turn to page 68 of the Student Module Booklet and begin Section 3.

ASSIGNMENT BOOKLET DECLARATIONS

The Student's Declaration is to be signed by a student registered at the Alberta Distance Learning Centre. If the student is under 16, the Supervisor's Declaration is to be signed by the student's supervisor, who is usually a home instructor, teacher, or home-schooling coordinator. Failure to complete this page may invalidate the assignment results.

STUDENT'S DECLARATION

- I have followed the instructions outlined in the Student Module Booklet.
- I have completed the activities to prepare myself for the assignments in this Assignment Booklet.
- I completed the assignments in this Assignment Booklet by myself.

_____

Student's Signature

SUPERVISOR'S DECLARATION

I hereby certify that I have supervised the learning activities completed by _____.

Student's Name

I also certify that to the best of my knowledge the assignments in this Assignment Booklet were completed independently by this student.

_____

Supervisor's Signature

If you, the student or supervisor, have any comments or observations regarding this module, write them in the following space.

_____

_____

_____

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